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This paper provides logit estimates of the probability that students will cheat in a specific class using randomized response and direct question data in two logit models. The results predict that there are several indicators of the probability of cheating occurring in a class. These factors include both student and instructor characteristics. They suggest several steps that can be taken to reduce the incidence of cheating which are relatively inexpensive yet potentially very successful. Further, this study explores the usefulness of the randomized response survey technique in obtaining information about sensitive behavior.

Estimates indicate that there are steps that instructors can take to reduce the amount of cheating that takes place in their classes. This study suggests that using multiple versions of each exam, non-multiple choice exams and reducing the weight of each exam score toward the final course grade are all measures which will lower the incidence of academic dishonesty in a class.

By allowing a respondent more anonymity the randomized response method encourages more truthful answers than direct questioning. In both models studied here, randomized response yields higher estimates of cheating.

The randomized response estimates also appear to be more consistent with previous estimates of cheating than do the direct question estimates. This lends confidence to the conclusion that when surveying respondents about potentially sensitive or threatening information the direct question method yields inaccurate predictions of actual behavior and randomized response is a more appropriate methodology.

FACTORS RELATED TO ACADEMIC DISHONESTY AMONG OREGON UNDERGRADUATES: AN APPLICATION OF THE RANDOMIZED RESPONSE SURVEY TECHNIQUE

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I. INTRODUCTION

Academic dishonesty, or cheating, can be broadly defined as "any knowing violation of course rules which could potentially increase course credits" or grade (Gardner et al., 1988 p. 544). This includes the copying of answers during an exam, obtaining a copy of an exam prior to taking it, taking an exam for another student or giving answers during an exam. In studies performed by Singhal (1982), Tittle and Rowe (1973), the Carnegie Commission on Education (1979), Kerkvliet (forthcoming a), Haines et al. (1986), Bunn et al. (1992), Nelson and Schaefer (1986), Tittle and Rowe (1974) and Houston (1983), the percentage of college students who cheat at least once during their academic careers has been estimated at between 20% and 56%. This would indicate that cheating on college campuses is a widespread problem. College grades are used by prospective employers or graduate programs as an indicator of a student's abilities. Grades that have been obtained due to cheating serve as a false basis for this judgement, and thus punish those students who have not cheated (Tullock and McKenzie, 1985). Cheating on college campuses is an issue of great importance that needs to be addressed.

This paper uses econometric analysis of survey data to estimate the incidence of cheating on college examinations and find the characteristics of students, instructors, class setting and testing methods which are most likely to influence the probability that a student will cheat. Unlike previous studies of cheating which have focused solely on student characteristics related to academic dishonesty in general, this paper examines the student, instructor, class and testing method effects on the incidence of cheating in a specific class. I am especially interested in whether the models indicate any actions taken by instructors that may reduce cheating.

Students responded to a question about cheating on exams in the class in which they are surveyed and about their personal, academic and socioeconomic characteristics. These characteristics include the students' gender, ethical beliefs, study habits, performance on a previous exam in the class, grade point average, criminal history, alcohol consumption, academic status and residency in a fraternity or sorority. Instructors' characteristics include their testing methods and other actions taken to reduce cheating. Finally, the number of students in a class is recorded for inclusion in the models of cheating presented here. The effects of these characteristics on the probability of cheating are estimated using dichotomous choice maximum likelihood models.

Students in ten undergraduate Principles of Micro and Macro-economics classes were surveyed at two universities about their personal characteristics and cheating behavior in the specific class in which the survey was administered. The six instructors of these classes were asked about the testing methods and class characteristics for the class being surveyed. The wide range of data obtained allows comparisons not only across students, but between classes as well.

One major drawback of using direct question (DQ) surveys to collect research data about sensitive behavior is that when attempting to elicit responses to potentially sensitive questions, many respondents either refuse to answer or give untruthful answers (Chaudhuri and Mukerjee, 1988). Warner (1965) introduced the randomized response (RR) survey technique in an attempt to combat this defensive stance by respondents. By more thoroughly assuring respondents of anonymity, randomized response encourages more frequent and truthful responses to questions about sensitive behavior (Nelson and Schaefer, 1986). Although exceptions remain, in recent studies by Brewer (1981), Fox and Tracy (1986) Duffy and Waterton (1988) and Kerkvliet (forthcoming a,b), randomized response methods yield significantly different results compared to direct question surveys.

The next section of this paper will provide a brief discussion of Becker's (1968) theory of criminal behavior as it relates to academic dishonesty. Section III explains the methodology used for measuring cheating in this study. Section IV describes the models employed. Section V is a discussion of the results obtained and the final section presents conclusions.

II. THEORY OF ACADEMIC DISHONESTY

From an economic point of view, cheating behavior can be seen in much the same light as criminal activity. Individuals are assumed to maximize personal utility subject to the potential costs involved. Becker (1968) proposed the first widely accepted economic model of crime which theorized that a criminal is an economically rational, utility maximizing individual who weighs the expected personal benefits and costs of committing a crime and forms decisions appropriately. The model used for this paper follows directly from his work.

Like Becker's criminal, a rational, utility maximizing student will cheat if the expected benefits from cheating exceed the expected costs. The benefits and costs are weighted by the probability of success or failure at cheating and the probability of punishment if the cheating is detected.

For the i^{th} student, the utility associated with cheating is a direct function of the expected net benefits resulting from the cheating behavior. Specifically, the i^{th} student's expected utility associated with cheating is as follows:

$$U_{i,c}=p_k U_i(B|T) + (1-p_k)U_i(C|T). \qquad (1)$$

$U_{i,c}$ represents the expected utility from cheating. B is a vector of benefits derived from cheating. T represents a vector of personal taste variables. C is the vector of perceived costs of cheating, and p_k and $1-p_k$ are the probability of success and detection or punishment, respectively, in the k^{th} class given the combination of characteristics for the i^{th} student and k^{th} class.

Conversely, the expected utility of not cheating is

$$U_{i,nc}=U_i(B^*|T) + U_i(C^*|T), \qquad (2)$$

where B^* is the vector of benefits derived from not cheating and C^* is the vector of costs from not cheating. A student will cheat if and only if the expected net utility to be gained from cheating is positive, or:

$$U_{i,c}-U_{i,nc} > 0. \qquad (3)$$

The benefits to cheating include the psychic benefits arising from receiving good grades on an exam or in a course or praise from family or peers. Also included might be the potential monetary or future academic and career benefits from receiving higher grades, such as receiving more lucrative employment offers (Bunn et al., 1992). The potential costs involved are the punishment imposed by the instructor or university if cheating is detected, such as expulsion from school, failing an exam or a course, psychic costs imposed by family or friends if the student is caught cheating, and the possibility of perhaps having a permanent record of dishonesty placed in the student's academic file.

These benefits and costs are not only student-specific, but also can vary by instructor. Different instructors may take different precautions to increase the costs of cheating or the probability of detection in their classes These may include separating students during exams, including questions that require mathematical computation on exams or disseminating several copies of each exam. Different combinations of these factors will potentially influence the probability of detection or punishment and, in turn, the incidence of cheating in a given class.

III. MEASURING ACADEMIC DISHONESTY

When queried about sensitive behavior, many people either give answers that are less than completely honest or are hesitant to respond (Chaudhuri and Mukerjee, 1988). The purpose of the randomized response survey method is to provide further anonymity to people being questioned regarding subjects which may carry negative social stigma. This includes questions about personal finances, addictive behavior, illegal activity and similar activities which may be disapproved of by society.

In the RR method the probability that a respondent is answering a question is not equal to unity, and more truthful responses and higher response rates than DQ surveys are encouraged. Because the researcher cannot know for certain whether the respondent is answering the sensitive question, the privacy of the respondent is protected and the respondent is more inclined to respond honestly (Fox and Tracy, 1980). The ability of the technique to eliminate these evasive answer and non-response biases has been tested with slightly ambiguous results. Brewer (1981) found, for example, that randomized response actually yielded a lower estimate of illegal drug use than did direct question data. However, in the majority of studies, including those by Kerkvliet (forthcoming a,b), Fox and Tracy (1980 and 1986) and Duffy and Waterton (1988), higher positive response rates on sensitive questions were achieved using randomized response.

Since this paper models cheating in the specific class where students were surveyed, the information sought is especially sensitive due to the time frame involved and locale in which the surveys were administered. In previous studies of cheating respondents were able to distance themselves from their responses since it was not necessary to reveal how recently the cheating took place. Students in this study, however, are asked about cheating behavior on exams in the class in which they are surveyed. If detected, the cheating could affect their academic success. Since it can be expected that "questions about the past are less threatening than questions about current behaviour," (Sudman and Bradburn, 1982, p.77 in Duffy and Waterton, 1988, p.12) and thus randomized response is especially appropriate for use in this study.

The survey was administered to 466 students enrolled at two universities in ten separate classes with seven different instructors. Of these, 455 students (97.6%) provided usable responses to the sensitive question. All responses to the sensitive question on the DQ surveys were usable (N=133) and 96.6% of the RR surveys contained usable responses to the sensitive question (N=333).

The two survey types were randomly mixed prior to being distributed to students. One-fourth of the students were given surveys in which the sensitive question was presented in the direct question form

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Have you ever cheated on an exam in this course?
Yes _____ *No* _____

The remaining three-fourths was asked the question in the randomized response formation. This proportion was not constant for each class but was achieved in the aggregate.

Instructors for each of the ten classes were orally questioned to obtain the weight of each test given toward final class grade, the dominant testing method used (e.g multiple choice, essay or short answer questions) and any actions taken to mitigate cheating in their classes. This data includes the number of questions on each exam requiring calculation, the number of students enrolled in the class and the number of versions of each test, and is presented by class in TABLE 5. These variables are included in the models because they are all believed to be correlated with the probability that a student will cheat on an exam.

Prior to the surveys being administered, students were assured via oral instructions from the surveyor that the responses given to the survey questions would in no way affect their grades or be used to "catch" cheaters. Also, all surveys included the following written instructions:

An economics faculty member is interested in testing a new survey technique. He would greatly appreciate the information that you would provide by participating in this survey.

In this survey, there are some questions about the sensitive topics of academic cheating and drug use. In order to encourage truthful responses on your part, it is important that your identity is <u>not</u> revealed.

Therefore: ***DO NOT WRITE YOUR NAME OR PLACE ANY IDENTIFYING MARKS ON THIS QUESTIONNAIRE.***
Repeat: ***IN ORDER FOR THIS SURVEY TO BE USEFUL IT IS IMPORTANT THAT YOUR IDENTITY IS NOT REVEALED. DO NOT WRITE YOUR NAME ON THESE SHEETS OF PAPER.***

Finally, it should be noted that the person administering the survey was never the instructor of the class being surveyed. These precautions were designed to further lower students' hesitations about providing honest responses.

The students receiving randomized response surveys were then given the following instructions:

To ensure your privacy regarding the sensitive nature of the following three questions, it will be necessary that you compute a random number from your social security number. ***THIS NUMBER IS NOT YOUR SOCIAL SECURITY NUMBER AND <u>CANNOT</u> BE USED TO FIND YOUR SOCIAL SECURITY NUMBER.*** *This random number is the sum of the last four digits of your social security number. For example, if your social security number is*

517-48-1234

your random number is

1 + 2 + 3 + 4 = 10

Now compute your random number using your social security number. Do <u>NOT</u> write or speak this number, but remember it for the next three questions. Please answer the next three questions honestly. Your answers cannot be traced to you, nor do we have any interest in doing so. We are only interested in trying a statistical procedure.

In the box below write either a "0" or a "1".
Write a "1" if your random number is between 0 and 7.
Write a "0" if your number is between 8 and 11.
Write a "1" if your number is between 12 and 36 and if you have <u>ever</u> cheated on an exam in <u>this</u> course.
Write a "0" if your number is between 12 and 36 and if you have <u>never</u> cheated on an exam in <u>this</u> course.

Write a "0" or "1" here. ■

Using this method, only the probability of a student responding to the sensitive question can be known. Let π be the true proportion of cheaters in a class, and R_i be the indicator response given to the cheating question by the i^{th} student, coded 1 and 0 respectively. Denote ρ_j the calculated probability that the random number generated by the student is in the j^{th} interval, $j = 1,2,3$ and in the above example, $j=1$ for $\{0,7\}$, $j=2$ for $\{8,11\}$ and $j=3$ for $\{12,36\}$. These intervals and their associated calculated probabilities of occurrence are included as TABLE 4. Note that for each class there exists more than one set of intervals. Using the ρ_i's, the probability of a student giving each of the responses for the randomized response question is then:

$$P(R_i=1)=\rho_1 + \rho_3\pi, \qquad (4)$$

$$P(R_i=0)=\rho_2 + \rho_3(1-\pi), \qquad (5)$$

where $\rho_3=(1-\rho_1-\rho_2)$.

For the DQ surveys, $\rho_1=\rho_2=0$ and $\rho_3=1$ so it follows that:

$$P(R_i=1)=\pi \quad \text{and} \qquad (6)$$

$$P(R_i=0)=(1-\pi). \qquad (7)$$

One disadvantage associated with using RR data is that because of the reduced probability of response to the sensitive question, the effective number of usable responses to the sensitive question diminishes (Duffy and Waterton, 1988). Further, there is a necessary bias versus variance tradeoff when using RR. As the probability of responding to the sensitive question (ρ_3 in the models presented) is reduced, it is expected that the bias of the estimates will decrease due to increased honesty in responses. At the same time, the variances of the estimated probabilities will increase because of the increased uncertainty (Fox and Tracy, 1986).

In picking a value for the ρ_j's, attention must be given to choosing a value such that the respondent feels sufficiently anonymous to honestly answer the question and which provides estimates with relatively low variances (Fox and Tracy, 1980). In this study several different sets of intervals were used. This helps to reduce convergence problems during the maximum likelihood estimations. In addition, it can be expected that different sets of ρ_j's would produce different estimates of π (Greenberg et al., 1971). However, this paper does not pursue this issue further.

IV. MODELS USED FOR ESTIMATION

The probability that a student has cheated is equal to the probability that the net benefits of cheating were positive during at least one exam in the course in which the student was surveyed. X_i is a 1xk vector of characteristics measuring tastes, costs and benefits of cheating for the i^{th} student and instructor variables affecting the costs and benefits of cheating and the probability of detection. Using a logit representation, the probability that a student has cheated in the surveyed class is written as:

$$\pi = \frac{e^{\beta' X_i}}{1+e^{\beta' X_i}}, \qquad (8)$$

where β is a 1xk vector of parameters to be estimated by maximizing the likelihood function:

$$L = \prod_{y_i=1} [\rho_1 + (1-\rho_1-\rho_2)\frac{e^{\beta' X_i}}{1+e^{\beta' X_i}}] \prod_{y_i=0} [\rho_2 + (1-\rho_1-\rho_2)\frac{1}{e^{\beta' X_i}}]. \qquad (9)$$

For the purposes of this study, two models were estimated. The models were further divided by randomized response and direct question data. In MODEL 1, only the effects of the variables measuring student characteristics were estimated. Included are student variables that have been found to be statistically significant in previous studies of cheating. Additionally, two variables not previously studied in cheating models are included. All of these variables were obtained from self-reported responses to questions in the survey.

For this model, $\beta' X_i$ was specified as:

$$\beta' X_i = \beta_0 + \beta_1{*}ALC_i + \beta_2{*}ETH_i + \beta_3{*}CONV_i + \beta_4{*}PERS_i + \beta_5{*}STUDY_i + \beta_6{*}GPA_i + \beta_7{*}HOUSE_i + \beta_8{*}GEN_i + \beta_9{*}QUART_i. \quad (10)$$

ALC represents the amount of alcohol, in ounces, that a student reports consuming in an average week. It is hypothesized that the effect on cheating from this variable will be positive. Support for this comes from Kerkvliet (forthcoming a) who found that increased alcohol consumption led to increased cheating.

ETH and CONV are variables that attempt to quantify the degree of morality a student exhibits. Affiliation with a religious organization plays a significant role in all decision-making aspects of a person's life. (Glock, 1967) This can be extrapolated to include the behavior of students with respect to cheating. ETH is a binary variable equal to one if the student responded affirmatively to the following question and zero otherwise.

Do you adhere to a system of ethical or religious beliefs?

Cheating is an activity which is generally considered unethical or immoral. It can also be suggested that the majority of religions have a set of values related to the ethical behavior of their members. For these reasons, we would expect those students who respond affirmatively to the above question to respond negatively to the cheating question. Tittle and Rowe (1974) attempted to quantify the effect of morality on cheating in their study. Students in their study were told that they had a moral obligation to not cheat. Data from their model indicate that a moral appeal had virtually no effect on reducing the incidence of cheating. The use of a moral appeal in their model, however, does not seem to accurately reflect the degree of morality indigenous to the individual student. Instead, it appears to measure the level of control exerted by the instructor which influences the incidence of cheating. It is predicted that a more accurate indicator of ethical or moral beliefs, such as the variable introduced here, will exhibit a negative effect on cheating behavior.

CONV is a binary variable equal to one if a student reported in the following question that the student has been convicted of a crime:

In the last 3 years have you been convicted of breaking the law?

*Yes*____ *No*____

Cheating can be seen as a form of criminal behavior, although Bunn et al. (1992) argue that there is an important distinction to be made between cheaters and criminals. They contend that because the student from whom answers have been procured has not lost those answers, the non-cheaters are not victims in the same way as victims of theft. It is hypothesized that grades that are increased by cheating may lead to more prosperous job offers, acceptance to more prestigious graduate programs or result in some other form of monetary or academic benefit. These benefits may have been bestowed upon different, non-cheating students had the cheating not taken place. Contrary to the conclusions of Bunn et al. (1992) then, the cheater has stolen something from others and the comparison between crime and cheating is valid.

We expect that those people who have criminal backgrounds might also be more inclined to cheat. They possibly view the costs of being caught as lower than those with no criminal history. Further, if they have had a large proportion of criminal experience that was undetected, their estimate of the probability of detection may be reduced. Consequently, a higher incidence of cheating will be promoted. These factors would indicate a positive relationship exists between CONV and cheating. The opposite relationship could also be hypothesized. Since this variable is defined in terms of convictions, a person who responds affirmatively to this question is indicating that they were unsuccessful at criminal activity. This could lead them to increase their estimates of the probability of detection and punishment potentially, and their level of cheating will be reduced. This would indicate a negative relationship between CONV and cheating.

More information regarding a student's academic behavior and experience is included in the variables STUDY and PERS. STUDY is the number of hours in an average week that a student studies for the class in which the survey was administered. Since a higher degree of studying should better prepare the student and, ceteris paribus, lower the marginal benefits of cheating, STUDY should exhibit a negative relationship with cheating.

PERS is the percent score a student received on the last exam in the class surveyed. This potentially measures a certain level of mastery of course material. A student who has a higher aptitude for the subject matter, demonstrated by a larger value for PERS, will have lower marginal benefits to cheating. This is expected to be reflected in PERS having a negative effect on the probability of cheating.

GPA is the student's cumulative grade point average. In his study, Kerkvliet (forthcoming a) found no statistically significant correlation between GPA and cheating. Conversely, Bunn et al. (1992), Scheers and Dayton (1987) and Haines et al. (1986) all find an inverse relationship between GPA and cheating while Singhal (1982) finds only a slight difference in cheating rates between students with high GPA students and those with low GPA. This ambiguity in prior results leaves no definite hypothesis for the sign on GPA.

HOUSE is a binary variable equal to one for those students living in a fraternity or sorority and zero otherwise. It is predicted that residents of "Greek" houses will exhibit a higher incidence of cheating, reflected in a positive sign on the coefficient. This would reflect the fact that there is a good deal of competition among Greek houses in terms of grades. Consequently, more pressure is placed on each member to do well. This also supports the belief that fraternities and sororities foster an attitude of camaraderie among members which Houston (1986) found positively correlates with cheating. A positive coefficient on HOUSE is consistent with Kerkvliet's (forthcoming a) finding that residency in a fraternity or sorority was positively correlated with cheating.

GEN is a binary variable equal to one for males and zero for females. Houston (1983) and Haines et al. (1986) report that the gender of a student is unrelated to cheating. Kerkvliet (forthcoming a) finds that females are more likely to cheat than males. The current social climate places a great deal of pressure upon females to equal or exceed their male counterparts. Consequently, it is possible to theorize that females will cheat more than males in an attempt to gain a certain advantage. This would be reflected in a negative relationship between GEN and cheating. Conversely, we live in a male-dominated society in which men are still often expected to be the main bread-winners. We could, therefore, predict that males will feel more pressure to succeed academically in order to secure more prestigious or lucrative employment opportunities. This would cause the incidence of cheating among males to be greater than that experienced by females and a positive relationship between GEN and cheating would result.

QUART is the number of quarters a student has remaining until graduation. Earlier studies on cheating have shown no agreement on the sign for this variable. Haines et al. (1986) find little or no relationship between class status and cheating and Kerkvliet (forthcoming a) finds that the sign for the estimated coefficient on this variable is fragile with respect to survey type. Using RR data, he estimated a positive relationship between QUART and cheating, whereas parameter estimates using DQ data were negative. It can be predicted that the costs associated with being caught cheating are significantly lower for a student earlier in the academic career. A student who is caught cheating at an earlier point in an academic program is more likely to be able to recover from any sanctions imposed than one who is closer to graduation. A student close to completion of a degree faces not only the sanctions imposed by the professor or university, but also the possible loss of job opportunities or academic awards. A student earlier in an academic career however has the benefit of time to make amends and correct any academic deficiencies which may have resulted from the cheating. The student would, therefore, be more inclined to cheat. This would be exhibited by a positive sign on the coefficient for QUART. In contrast, a student early in his degree program may believe the sanctions imposed if cheating is detected to be quite costly. However, a large proportion of the time this is not the case due to the large costs imposed upon instructors in following through with university procedures for disciplining cheaters. As students witness cheating taking place with relatively low penalties being exacted, their estimates of the expected costs of cheating will diminish. The more opportunities a student has had to witness these occurrences, the lower will be the estimated costs and the more likely is the student to cheat. A negative relationship between QUART and cheating would then be predicted. There is therefore no definitive hypothesis regarding the sign on QUART.

In MODEL 2, all student, class and instructor variables are included. For the randomized response estimation of this model, $\beta'X_i$ was specified in the following way:

$$\beta'X_i = \beta_0 + \beta_1{*}ALC_i + \beta_2{*}ETH_i + \beta_3{*}CONV_i + \beta_4{*}STUDY_i + \beta_5{*}PERS_i + \beta_6{*}HOUSE_i + \beta_7{*}QUART_i + \beta_8{*}GPA_i + \beta_9{*}GEN + \beta_{10}{*}NUM_i + \beta_{11}{*}TYPE_i + \beta_{12}{*}QUES_i + \beta_{13}{*}VERS_i + \beta_{14}{*}FRAC_i \quad (11)$$

NUM is the number of students enrolled in the class surveyed. As the number of students in a classroom increases, it becomes more difficult for instructors to separate students during an exam. This decreases the probability of detection of cheating and should increase the probability that a student will cheat. A positive sign should result for NUM.

Instructors' testing methods were included in the models in three ways. TYPE is a binary variable equal to zero if an instructor uses exams that in any way include multiple choice questions and one for all other exam formats, including short answer, essay or a combination of the two. This variable attempted to measure the relative ease of copying answers on an exam. The basic nature of multiple choice exams facilitates cheating without detection, whereas short answer or essay exams would be much more difficult to copy without being detected, yielding a positive relationship between TYPE and the probability of cheating taking place. Unfortunatately, because of the distribution of this variable, it is impossible to determine exactly what effect it is measuring. All instructors at University A used non-multiple choice exams exclusively while all those at University B used exams containing multiple choice portions. This caused TYPE to be bimodally distributed and made it impossible to distinguish between the testing method effects we were attempting to identify and those effects that might vary by university.

QUES is the number of questions on an average exam which require the student to arithmetically calculate an answer. Because questions of this sort often require that a student demonstrate all the steps involved with solving a problem, answers would be more difficult to copy without being detected. This should result in a negative relationship between QUES and cheating.

VERS is the number of versions of each exam distributed by an instructor. Disseminating a variety of versions of an exam increases the difficulty of copying answers from a neighboring student, ceteris paribus. VERS should, therefore, be negatively correlated with cheating.

FRAC is the percentage weight of each exam score toward a student's final class grade. The greater the weight of each test, the more a student stands to gain from doing well on any given exam. The expected marginal utility associated with cheating on each exam would increase as FRAC increases and this would induce a higher degree of cheating and be exhibited in a positive sign on FRAC.

It should be noted that the direct question portion of this model was not fully estimatable. This was because there were only four positive responses to the sensitive question in 101 observations. This essentially created a null vector for the dependent variable. Because of this, results in the DQ portion of this model are highly suspect and should not be considered reliable. When estimates of the probability of cheating are compared across survey types in this model, more support for the use of RR is generated. The fact that there were only four positive responses in the DQ model indicates respondents' hesitancies in answering the sensitive question which is at least partially eliminated using RR. Additionally, there existed a high degree of multicollinearity among some of the independent variables that forced the removal of these variables from this model.

Parameters for the variables left in the DQ portion of this model were estimated as:

$$\beta' X_i = \beta_0 + \beta_1 {*} FRAC_i + \beta_2 {*} ALC_i + \beta_3 {*} ETH_i + \beta_4 {*} CONV_i + \beta_5 {*} STUDY_i + \beta_6 {*} PERS_i + \beta_7 {*} HOUSE_i + \beta_8 {*} QUART_i + \beta_9 {*} GPA_i + \beta_{10} {*} GEN_i \quad (12)$$

Means and standard deviations for all variables are presented by model and separated by survey type in TABLE 1. TABLE 2 presents this information by university. It is interesting to note that some substantial differences exist in variable means across the two universities. ALC, the variable for alcohol consumption, is more than 18 percent higher at University B. CONV, the proportion of students who have been convicted of crimes, is more than twice as high at University B and HOUSE, the level of fraternity or sorority residency is almost nine times as great at University B.

Additionally, note that the effective sample size (N) was reduced to only 378 observations. This is due to the fact that any observation with a missing value for one of the studied variables was dropped. ALC, QUART and PERS each had at least 30 missing values. The missing values for ALC are a result of survey design. Not included in the models presented here was a question on the surveys asking if the student had ever had a drink of alcohol. A negative response to that question necessitates a non-response to the question of quantity of alcohol consumed (ALC). The missing values for QUART possibly arise from uncertainty on the respondent's part about when they will complete their degree program. Because a large portion of the students surveyed were freshmen and sophomores it is reasonable to conclude that they may not have even declared a major yet and so may not know when they will graduate. In some of the classes surveyed, students are allowed to drop one exam score from their final grade. Because of this, some students elect to not take one of the exams in these courses. It is possible that the missing values for PERS reflect those cases in which the student did not take the previous exam in the class, and therefore does not have a score to report. They may also be a source of bias in this study. It could be theorized that those students not reporting previous exam scores received lower than average scores. Grades are perceived, in many cases, as an indicator of intellect or social status and those students receiving poor scores may not wish to reveal their scores due to embarassment or fear of judgement. If this is true, the variable PERS would be biased upward.

V. ESTIMATION AND DISCUSSION OF RESULTS

TABLE 3 presents the maximum likelihood estimates of β for each of the models.

Earlier studies of classroom cheating behavior have focused almost entirely on student characteristics as indicators of the probability of cheating and ignored the effect that instructors may have on the occurrence of cheating. This study broadens that view and estimates an alternative, MODEL 2, that includes not only student characteristics, but also instructor characteristics that may be correlated with the probability that students will cheat. Again, for this model, $\beta'X_i$ is specified as

$$\beta'X_i = \beta_0 + \beta_1{*}NUM_i + \beta_2{*}TYPE_i + \beta_3{*}QUES_i + \beta_4{*}VERS_i + \beta_5{*}FRAC_i + \beta_6{*}ALC_i + \beta_7{*}ETH_i + \beta_8{*}CONV_i + \beta_9{*}STUDY_i + \beta_{10}{*}PERS_i + \beta_{11}{*}HOUSE_i + \beta_{12}{*}QUART_i + \beta_{13}{*}GPA_i + \beta_{14}{*}GEN_i \qquad (12)$$

Four likelihood ratio tests were performed using this fully inclusive model to determine if the full model is a more accurate predictor of cheating than one which includes only student or only instructor characteristics. The statistic is calculated as:

$$D = -2[\ln(L2) - \ln(L1)] \qquad (13)$$

where ln(L1) is the natural logarithm of the likelihood function for the full model and ln(L2) is the log of the likelihood for a restricted model. The statistic follows a χ^2 distribution, with degrees of freedom equal to the number of omitted variables. The maintained hypothesis for this test is that the restricted model is an equally good predictor as the full model, or that the full model includes some irrelevant variables.

To test the hypothesis that instructor characteristics play no part in determining the probability of cheating, the fully inclusive RR model is compared against a student characteristics only RR model. The calculated $\chi^2=21.3698$ with five degrees of freedom and the null hypothesis is rejected at the $\alpha=.005$ level. Testing the same hypothesis using the DQ data yields a $\chi^2=4.3312$. Using $\alpha=.05$ the null is rejected in this model as well. These results indicate that the instructor characteristics studied do play a role in predicting the probability of cheating.

Testing the hypothesis that, in the RR model, student characteristics have no effect on the probability of cheating produces a calculated $\chi^2=31.0954$ with nine degrees of freedom. This is rejected at the $\alpha=.005$ level. As expected, the hypothesis is also rejected using the DQ data.

Because both student and instructor characteristics were found to be relevant using the likelihood ratio test, it is concluded that a model that includes both of these groups is the correctly specified model.

The RR portion of MODEL 2 includes all of the student variables and all of the instructor characteristics studied. The estimated coefficients on NUM, TYPE, FRAC, ALC, GPA and VERS in this model are all significant at or above the $\alpha=.05$ level.

All of the variables except NUM exhibit the same qualitative relationship with cheating as previously hypothesized. The results indicate that instructors who use multiple versions of short answer or essay style exams and who offer several exams throughout the course will encounter a lower incidence of cheating in their classes. These would appear to be relatively inexpensive, yet effective, means of reducing the occurrence of cheating.

Somewhat counter-intuitively, we find that the number of students in a class is inversely related to the probability of cheating. In the context of this study, though, the negative sign on the parameter estimate for NUM can be explained by recognizing a weakness of the models. In this study NUM may serve as a sort of proxy for the university at which a survey was administered. The two universities used in this study are quite different in terms of size. University A is a small state college with an enrollment of approximately 2,000 students. All classrooms on the campus are roughly the same size and have approximate seating capacities of 30 students. Each of the Principles of Economics classes surveyed at this school had enrollments close to this capacity, causing students to be in close proximity to one another during exams. On the other hand, University B is a large state university with an enrollment near 17,000. The classrooms used for Principles of Economics classes on this campus, in most cases, have seating capacities that are 2-3 times as large as class enrollment. This allows instructors to disperse students during examinations to prevent cheating. What occurred as a result of these differences is that the variable NUM became distributed at two extremes representing each of the two schools and did not accurately reflect the separation of students during exams as was intended. For future studies of this nature it is therefore recommended that any variable for number of students should be modified to represent the number of students per square foot of classroom space or number of chairs per student. This may give a better indication of the dispersion of students during an exam.

Further, the results from this model suggest that students who consume larger quantities of alcohol and who have relatively low grade point averages will cheat more than their more sober, more academically successful colleagues. It might be predicted that alcohol consumption is negatively correlated with academic success (e.g. GPA) and so measures taken to reduce the level of alcohol consumption on college campuses would have the combined benefits of raising students' grade point averages and diminishing the amount of cheating.

The DQ portion of MODEL 2 includes all of the student variables and adds the variable FRAC. This was the only instructor variable which could be included in the model and still allow estimation. As mentioned earlier, the DQ portion of this model was difficult to estimate due to singularity in the data. There were estimated correlations of -0.96 between the variables NUM and TYPE and 0.95 between QUES and VERS.

The correlation between NUM and TYPE is reflective of the costs to instructors of reducing cheating. It indicates that in larger classes, instructors are more inclined to use multiple choice examinations which tend to be much easier to score than short answer or essay exams. That QUES and VERS are positively correlated may indicate that those instructors who attempt to reduce cheating in their classrooms try several methods for doing so. Not only do they distribute several versions of each exam, but they also include questions which require calculation.

For this portion of MODEL 2, only the parameter estimate for QUART is statistically significant (α=.10). This estimate indicates that the earlier a student is in an academic career, the higher is the probability that the student will cheat. Using RR data, the estimated coefficient is positive, whereas using DQ data a negative relationship is estimated between QUART and cheating. As was the case in Kerkvliet (forthcoming a) the parameter estimate is fragile with respect to survey type so caution is advised in interpreting its effect. One possible explanation for this fragility is that students who are close to completion of their academic career have more to lose if they are caught cheating and are therefore less willing to respond affirmatively when directly asked about cheating. When faced with the anonymity offered by the randomized response though, they are more willing to answer honestly about their cheating behavior and thus the sign on the parameter estimate changes. This explanation would be consistent with the effect hypothesized in section IV.

Comparing across models, some conclusions can be drawn. The probability of a cheating was estimated at the sample means of the variables using the estimated coefficients. In all cases estimates using the RR data are higher than those using DQ data. This is precisely the predicted result. RR estimates range from .059 to .101 and DQ estimates range from 4.31 E-09 to .0006.

As a measure of reliability of our estimates, we compare the results obtained here with those from other studies. The average degree program requires twelve quarters to complete. Each of these quarters consists of an average of four classes for a total of 48 classes. For ease of explanation, we shall assume these classes to be consecutively ordered. Let i denote the i^{th} class, $i=\{1..48\}$. Assume that cheating in one class is independent of cheating in any other. $P^i(NC)$ is the probability that a student has not cheated in any class, up to and including the i^{th} class. For the data presented here, the mean number of quarters completed is three (not including the quarter in which the student was currently enrolled). This equates to an average of 12 classes completed. Given the estimated .941 probability that a student has not cheated in the surveyed class obtained from the RR data, the probability of that student having <u>never</u> cheated is then $P^{12}=.059^{12}=.482$. The probability that the student has cheated at some time is equal to $(1\text{-}P(NC))=(1\text{-}.482)=.518$. This is within the 20-56% range obtained in previous studies of cheating.

Using the DQ estimate that a student has not cheated in the surveyed class of .9994, the associated probability of that student having <u>ever</u> cheated is .0072.

The fact that the estimates obtained using DQ data were extraordinarily different from estimates of the probability of cheating in previous studies makes the use of the DQ method highly suspect. Additionally, the substantial difference between the RR and DQ estimates calls into question the validity of the DQ method when seeking potentially sensitive information.

Unlike past studies of cheating, this study found no statistical significance for GEN and HOUSE, the variables measuring gender and fraternity or sorority residence. While the estimated coefficient on HOUSE was consistent with the predicted result, a positive relationship was estimated between GEN and cheating. This would possibly indicate that males who live in fraternity houses are more likely to cheat, ceteris paribus.

Further, the two measures of morality, ETH and CONV were not found to be statistically significant. Also, in the randomized response model, both variables exhibit relationships to cheating that are opposite from what was predicted. This suggests that these variables may be incorrectly specified.

Contrary to what has been predicted about the use of randomized response, response rates in this study were lower for RR (96.6%) surveys than for DQ (100%). This might reflect a certain confusion or suspicion on the part of respondents to the unusual nature of randomized response questions. For example, confusion was evident on some of the surveys used in that even after being given both written and oral instructions not to place any indicating marks on the surveys, several respondents wrote their social security numbers near the randomized response section.

VI. CONCLUSIONS

This paper provides logit estimates of the probability that students will cheat in a specific class using randomized response and direct question data in two logit models. The results predict that there are several indicators of the probability of cheating occurring in a class. These factors include both student and instructor characteristics. They suggest several steps that can be taken to reduce the incidence of cheating that are relatively inexpensive yet potentially very successful. Further, this study explores the usefulness of the randomized response survey technique in obtaining information about sensitive behavior. Estimates do indicate that there are steps that instructors can take to reduce the amount of cheating which takes place in their classes. This study suggests that using multiple versions of each exam, non-multiple choice exams and reducing the weight of each exam score toward the final course grade are all measures which will lower the incidence of academic dishonesty in a class. All of these are uncomplicated and economical ways for instructors to mitigate cheating. Given this, it would seem that the costs of reducing cheating are far outweighed by the potential benefits.

By allowing a respondent more anonymity the randomized response method encourages more truthful answers than direct questioning. In both models studied here, randomized response yields higher estimates of cheating. The randomized response estimates also appear to be more consistent with previous estimates of cheating than do the direct question estimates. This lends confidence to the conclusion that when surveying respondents about potentially sensitive or threatening information the direct question method yields inaccurate predictions of actual behavior and randomized response is a more appropriate methodology.

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APPENDIX

TABLE 1
MEANS AND STANDARD DEVIATIONS

	MODEL 1		MODEL 2	
	DQ	RR	DQ	RR
NUM	***	***	79.16 (26.25)	76.42 (23.01)
TYPE	***	***	.584 (.495)	.114 (.318)
VERS	***	***	1.84 (.977)	1.67 (.813)
FRAC	***	***	.320 (.092)	.323 (.083)
ALC	31.12 (62.14)	31.64 (66.35)	31.12 (62.14)	31.64 (66.35)
ETH	.782 (.415)	.769 (.422)	.782 (.415)	.769 (.422)
CONV	.317 (.468)	.238 (.427)	.317 (.468)	.238 (.427)
STUDY	3.34 (2.95)	2.87 (2.13)	3.34 (2.95)	2.87 (2.12)
PERS	.775 (.136)	.755 (.160)	.776 (.137)	.755 (.160)
HOUSE	.158 (.367)	.161 (.368)	.158 (.367)	.161 (.368)
QUART	7.93 (3.45)	7.87 (3.55)	7.93 (3.45)	7.87 (3.55)
GPA	2.93 (.479)	2.96 (.456)	2.93 (.479)	2.96 (.456)
GEN	.594 (.494)	.557 (.498)	.594 (.494)	.557 (.498)

***** Not estimated for this model**

TABLE 2
MEANS AND STANDARD DEVIATIONS

	UNIVERSITY A	UNIVERSITY B
NUM	18.20 (2.16)	85.24 (10.37)
TYPE	1.00 (0.00)	0.00 (0.00)
QUES	.533 (.894)	2.61 (1.63)
VERS	1.00 (0.00)	1.81 (.874)
FRAC	.326 (.045)	.322 (.089)
ALC	26.98 (52.37)	31.95 (66.47)
ETH	.867 (.344)	.763 (.426)
CONV	.133 (.344)	.276 (.448)
STUDY	3.08 (2.20)	3.01 (2.41)
PERS	.788 (.135)	.756 (.158)
HOUSE	.022 (.149)	.180 (.385)
QUART	8.04 (2.95)	7.91 (3.62)
GPA	2.94 (.450)	2.96 (.463)
GEN	.467 (.505)	.583 (.494)
N	45	333

TABLE 3
MAXIMUM LIKELIHOOD ESTIMATES
AND ABSOLUTE t-VALUES

	MODEL 1		MODEL 2	
	DQ	RR	DQ	RR
CONSTANT	-.450 (.096)	2.47 (1.30)	23.08 (1.40)	11.46 (2.99)
NUM	***	***	***	-.118 (3.57)
TYPE	***	***	***	-9.19 (3.63)
VERS	***	***	***	-.877 (1.70)
FRAC	***	***	-51.68 (1.35)	9.20 (1.99)
ALC	-.025 (.729)	.0057 (2.01)	-.070 (1.23)	.0082 (2.29)
ETH	-.346 (.214)	.562 (.989)	-3.41 (1.20)	.661 (1.10)
CONV	-10.268 (.052)	.091 (.178)	-10.86 (.115)	-.124 (.226)
STUDY	.090 (.666)	-.224 (1.61)	.027 (.188)	-.125 (.891)
PERS	-.499 (.113)	-1.93 (1.47)	.160 (.028)	-1.21 (.792)
HOUSE	.982 (.564)	.446 (.800)	.045 (.025)	.661 (1.01)
QUART	.257 (1.57)	-.028 (.403)	.606 (1.71)	-.132 (1.59)
GPA	-1.555 (1.20)	-1.000 (1.92)	-5.29 (1.50)	-1.43 (2.47)
GEN	-.239 (.192)	-.225 (.450)	1.66 (.786)	.042 (.075)
π AT MEAN	.0006	.097	1.32 E-05	.059
N	101	273	101	273

***** Not estimated for this model**

TABLE 4
EMPIRICAL ρ VALUES
BY CLASS NUMBER

	UNI B							UNIV.A		
INTERVAL	1	2	3	4	5	6	7	8	9	10
0-3	0	0	0	***	0	.011	0	.053	0	0
0-5	.012	***	.021	.020	0	.021	0	.053	.039	0
0-7	.012	.011	.043	***	.024	.037	.037	.158	.039	.063
0-8	***	***	.075	***	.024	***	***	***	***	***
4-8	***	***	.043	***	.024	***	***	***	***	***
4-11	.136	.117	.117	***	.179	.168	.168	.158	.192	.25
6-11	.123	***	.096	.087	.179	.158	.158	.158	.154	.25
8-11	.123	.097	.075	***	.155	.105	.105	.053	.154	.188
9-15	***	***	.266	***	.310	***	***	***	***	***
9-36	***	***	.947	***	.976	***	***	***	***	***
12-36	.864	.893	.883	.893	.821	.821	.821	.790	.808	.75
16-36	***	***	.660	***	.667	***	***	***	***	***

*****Not used as an interval for this class**

TABLE 5
INSTRUCTOR CHARACTERISTICS
BY CLASS NUMBER

UNIV	CLASS	NUM	TYPE	FRAC	VERS	QUES
B	1	64	0	.30	2	2
B	2	94	0	.25	3	5
B	3	90	0	.3	4	1
B	4	80	0	.285	2	2
B	5	79	0	.75	1	1
B	6	97	0	.5	1	2
B	7	81	0	.25	3	5
A	8	21	1	.3	1	0
A	9	16	1	.3	1	0
A	10	18	1	.4	1	2